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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/672,029

09/25/2003

Thomas S. Dory

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04/27/2006

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EXAMINER

VAN, LUAN V

ART UNIT

PAPER NUMBER

1753

DATE MAILED: 04/27/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/672,029

Applicant(s)

DORY ET AL.

Examiner

Luan V. Van

Art Unit

1753

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 27 March 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-15 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-15 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Response to Amendment

Applicant's amendment of March 27, 2006 does not render the application allowable.

Status of Objections and Rejections

All rejections from the previous office action are maintained.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless -

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-15 are rejected under 35 U.S.C. 102(b) as being anticipated by Palmans et al.

Regarding claims 1 and 9, Palmans et al. teach a method of forming a microelectronic structure forming a recess in a substrate (figure 7-8); forming a non-continuous metal layer (i.e., Ti/TiN layer by physical vapor deposition or atomic layer CVD, column 7 lines 53-56) within the recess; activating (column 6 lines 58-67) the non-continuous metal layer and at least one non-deposited region within the recess;

Art Unit: 1753

electrolessly depositing a seed layer (column 7 lines 8-24) on the non-continuous metal layer and on the at least one non-deposited region within the recess; and forming a metal fill layer over the seed layer (column 8 lines 12-46). Since the metal layer or Ti/TiN barrier layer of Palmans et al. is deposited by the same method and conditions in features having the same aspect ratios as those of the instant claims, the Ti/TiN layer of Palmans et al. would be non-continuous.

Regarding claim 2 and 10, Palmans et al. teach forming a high aspect recess comprising an aspect ratio up to 3.5 (column 8 lines 37-46), which is within the range of the instant claim.

Regarding claim 3 and 11, Palmans et al. teach forming a non-continuous comprising of Ti/TiN (column 6 lines 49-51).

Regarding claim 12, Palmans et al. teach electrolessly depositing a copper layer comprising a grain size of about 1 μm or greater, since the copper layer of Palmans et al. is deposited by the same method and conditions as those of the instant claim.

Regarding claim 4-5, Palmans et al. teach depositing an activation layer wherein the activating layer within the recess comprises of palladium (column 6 lines 58-67) is formed on the non-continuous metal layer and the at least one non-deposited region within the recess.

Regarding claims 6, 13 and 15, Palmans et al. teach electroplating a copper layer on the seed layer (column 8 lines 35-46).

Regarding claim 7, Palmans et al. teach utilizing a chemical mechanical polishing process (column 8 lines 27-31).

Regarding claim 8 and 14, Palmans et al. teach forming a substantially void free metal fill layer, since Palmans et al. use the same plating method as that of the instant claims.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claim 1-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shelnut et al. (EP 1201786) in view of Palmans et al.

Regarding claims 1 and 9, Shelnut et al. teach a method of forming a microelectronic structure forming a recess in a substrate (paragraph 32); forming a non-continuous metal layer (i.e., TiN layer by physical vapor deposition, example 1) within the recess; electrolessly depositing a seed layer (paragraph 25) on the non-continuous

Art Unit: 1753

metal layer and on the at least one non-deposited region within the recess; and forming a metal fill layer over the seed layer (paragraph 26). Since the metal layer or TiN barrier layer of Shelnut et al. is deposited by the same method and conditions in features having the same aspect ratios as those of the instant claims, the TiN layer of Shelnut et al. would be non-continuous.

The difference between the reference to Shelnut et al. and the instant claim is that the reference does not explicitly teach activating the non-continuous metal layer.

Palmans et al. teach depositing an activation layer wherein the activating layer within the recess comprises of palladium (column 6 lines 58-67) is formed on the non-continuous metal layer and the at least one non-deposited region within the recess.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Shelnut et al. by activating the non-continuous metal layer as taught by Palmans et al., because it would form a catalytic surface in order for the seed layer to deposit on the barrier layer.

Relevant to claims 4-5, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Shelnut et al. by activating the non-continuous metal layer using palladium as taught by Palmans et al., because a skilled artisan would be able to select from among known suitable activating metals, and because it would form a catalytic surface in order for the seed layer to deposit on the barrier layer.

Art Unit: 1753

Regarding claim 2 and 10, Shelnut et al. teach forming a high aspect recess comprising an aspect ratio up to 15 (paragraph 32), which is within the range of the instant claim.

Regarding claim 3 and 11, Shelnut et al. teach forming a non-continuous comprising of TTiN (example 1).

Regarding claim 12, Shelnut et al. teach electrolessly depositing a copper layer comprising a grain size of about 1 μm or greater, since the copper layer of Shelnut et al. is deposited by the same method and conditions as those of the instant claim.

Regarding claims 6, 13 and 15, Shelnut et al. teach electroplating a copper layer on the seed layer (paragraph 26).

Regarding claim 7, Shelnut et al. teach utilizing a chemical mechanical polishing process (paragraph 33).

Regarding claim 8 and 14, Shelnut et al. teach forming a substantially void free metal fill layer (paragraph 26).

Response to Arguments

Applicant's arguments have been fully considered but they are not persuasive.

In the arguments presented on page 2 of the amendment, the applicant argues that Palmans et al. do not disclose forming a noncontinuous metal layer. The examiner respectfully disagrees. Since the metal layer Ti barrier layer of Palmans et al. is deposited by the same method (i.e., physical vapor deposition or atomic layer

Art Unit: 1753

deposition, see column 7 lines 53-56) and to a thickness range of 15 nm, or 150 Angstrom, (column 8 lines 20-24), in features having the aspect ratios of 2:1 or higher (column 9 lines 5-10), the Ti layer of Palmans et al. is inherently non-continuous. Furthermore, the background of the instant specification discloses that it is very difficult or impossible to sputter deposit a continuous seed layer on the sidewalls and bottom of a via having an aspect ratio of 3:1 or greater (page 3). Therefore, the Ti layer of Palmans et al. is non-continuous, because the features have aspect ratios of 2:1 or higher (column 9 lines 5-10).

In the arguments presented on page 3 of the amendment, the applicant argues that Shelnut et al. do not disclose forming a noncontinuous metal layer. The examiner respectfully disagrees. Since the metal layer or Ti barrier layer of Shelnut et al. is deposited by the same method (i.e., physical vapor deposition, see paragraph 37) and in features having the aspect ratios of 4:1 or higher (paragraph 32), the Ti layer of Shelnut et al. is inherently non-continuous. Shelnut et al. further disclose that a metal layer deposited by physical vapor deposition to a thickness of 50-1500 Angstroms (paragraph 5) suffers from discontinuities in the metal layer (paragraph 6). Therefore, a thin barrier layer deposited by physical vapor deposition as disclosed by Shelnut et al. would inherently be discontinuous.

Conclusion

Art Unit: 1753

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Luan V. Van whose telephone number is 571-272-8521. The examiner can normally be reached on M-F 9:30-6:00.

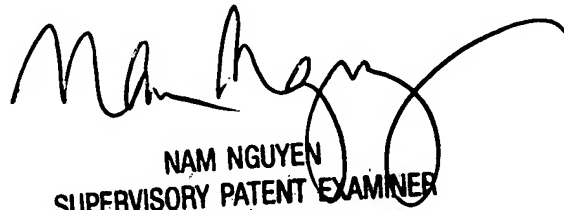
If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on 571-272-1342. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Art Unit: 1753

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

LVV

April 24, 2006



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SUPERVISORY PATENT EXAMINER
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